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Forced nuclear energy reactors shutdown in France: the Energy Transition Act's mechanisms

Romain Mauger*

ABSTRACT

In August 2015, the Energy Transition towards Green Growth Act set new targets aiming at a diversification of the electricity production mix in France. One of these goals requires France to diminish the share of nuclear energy in its electricity generation mix from an average of 75–50 per cent by 2025. To do so, the 2015 act created new legal tools to force the shutdown of various nuclear energy reactors. However, as this article highlights, these tools remain inadequate and inefficient to allow the Government to order the shutdown of a reactor for energy policy purposes. The first demonstration of this unsatisfactory situation was provided by the shutdown negotiation of the nuclear plant of Fessenheim, the oldest in operation. The lack of adapted legal mechanisms led to a costly agreement at the expense of public money. As it is, this situation seriously imperils the achievement of the electricity production diversification goals and the realization of the energy transition in France.

1. INTRODUCTION

The French nuclear programme has been rolled out since the 1970s as a reaction to the first oil crisis.¹ It led to the construction of 58 nuclear energy reactors, of which 54 were connected to the grid in only 16 years, from 1978 to 1994. In 1981 alone, eight reactors entered into operation.² As a result, the total installed nuclear capacity in France has been 63.2 GW since 2002.³ In 2016, it represented 72.3 per cent of the electricity produced in France, even though constituting ‘the lowest share since 1988’ because of a low load factor.⁴ This accomplishment was made possible by France’s ‘long tradition of state-centrism and top-down management’,⁵ or ‘Jacobinism’.⁶ However, the downsides of this rapid increase backed by the state are

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1 G Vindt, ‘1974 : le plan Messmer choisit l’option du tout-nucléaire’ *Alternatives Economiques* (1 September 2014) <www.alternatives-economiques.fr/1974-plan-messmer-choisit-loption-nucleaire/00067465> accessed 17 November 2017.

2 EDF, ‘Document de référence - Rapport financier annuel 2016’ (2017) 19 <www.edf.fr/sites/default/files/contrib/groupe-edf/espaces-dedies/espace-finance-fr/informations-financieres/informations-reglementees/document-de-reference/edf-ddr-2016-fr.pdf> accessed 24 November 2017.

3 *ibid.*

4 M Schneider and others, ‘The World Nuclear Industry Status Report 2017’ (2017) 44–45 <www.worldnuclearreport.org/IMG/pdf/20170912wnsr2017-en-lr.pdf> accessed 18 November 2017.

5 T Terävaïnen, M Lehtonen and M Martiskainen, ‘Climate Change, Energy Security, and Risk – Debating Nuclear New Build in Finland, France and the UK’ (2011) 39 *Energy Policy* 6, 3436.

6 B Sovacool, ‘The History and Politics of Energy Transitions – Comparing Contested Views and Finding Common Ground’ in D Arent and others (dir), *The Political Economy of Clean Energy Transitions* (OUP 2017) 18.

manifold. First, as multiple reactors are fast approaching their 40 years of operational life,⁷ the question of their revamping, replacement or decommissioning is a very acute one, creating a ‘cliff effect’.⁸ This situation entails the need for extensive investments in the energy system⁹ as well as the adoption of a legal framework adapted to the situation. Secondly, it has led to a situation described as nuclear lock-in, safeguarded by path-dependent political institutions,¹⁰ complicating the adoption of a legal framework which would break with the existing state of affairs.¹¹

In France, among the many texts composing the legal framework for nuclear energy, there are a few milestones: the 1961 Atmospheric Pollutions and Smells Act, placing nuclear energy in the polluting and hazardous industrial facilities’ regime;¹² a 1963 decree fully dedicated to its legal regime;¹³ the 2006 Transparency and Safety in Nuclear Matters Act, revising the regime for the creation, operation, shutdown and dismantling of nuclear energy facilities;¹⁴ and the 2015 Energy Transition Towards Green Growth Act (hereinafter Energy Transition Act), object of this article, which rewrote many articles of the past framework and created new legal mechanisms aiming at allowing the Government to force the shutdown of a nuclear reactor for other reasons than safety alone.¹⁵ The idea here is to fulfil one of the most disputed and symbolic provisions of the Act: the objective to diminish the annual nuclear energy share in the electricity generation mix from an average of 75–50 per cent by 2025 (hereinafter, 75–50 by 2025 target).¹⁶

This article assesses the mechanisms provided by the Energy Transition Act to reach this target by focusing on the upstream stage of nuclear energy facilities decommissioning: the forced shutdown of nuclear energy reactors and its recent legal regime in France. This stage constitutes a *conditio sine qua non* to a suitable decommissioning phase, as the thorough organization of the first step allows adequately preparing the second one.

Currently, there are only a few academic publications in English dealing with the French nuclear energy policy and even less on French nuclear energy law.¹⁷ Actually, most of the nuclear-related publications treat the topic from a technical,¹⁸ economic¹⁹ or social²⁰ point of view, or tackle it as part of wider energy policy questions.²¹ This article attempts to fill part of this gap, specifically concerning the legal tools available in France to organize the shutdown of nuclear facilities for reasons other than a direct safety threat.

7 Schneider and others (n 4) 46.

8 N Maïzi, and E Assoumou, ‘Future Prospects for Nuclear Power in France’ (2014) 136 *Applied Energy* 858.

9 The revamping option alone would cost EDF €²⁰¹³100 bn between 2014 and 2030. Cour des Comptes, ‘Le rapport public annuel 2016 – Tome I – Les observations’ (2016) <www.ccomptes.fr/sites/default/files/EzPublish/RPA2016-Tome-1-integral.pdf> accessed 24 November 2017.

10 R Pin Lee and S Gloaguen, ‘Path-dependence, Lock-in, and Student Perceptions of Nuclear Energy in France: Implications from a Pilot Study’ (2015) 8 *ERSS* 88.

11 Legal scholars highlight the conflicting debates on this point in Parliament. See P Billet, ‘Transition énergétique et croissance verte : itinéraire et ambitions d’une loi’ (2015) 10 *Énergie – Environnement – Infrastructures*, dossier 6, 6.

12 *Loi* no 61-842 du 2 août 1961 relative à la lutte contre les pollutions atmosphériques et les odeurs et portant modification de la loi du 19 décembre 1917. See MB Lahorgue, ‘Les conditions juridiques de la mise à l’arrêt définitif des INB et les stratégies de démantèlement de l’AIEA : le choix de la France’ (2014) 1 *RISEO*, 27.

13 *Décret* no 63-1228 du 11 décembre 1963 relatif aux installations nucléaires.

14 *Loi* no 2006-686 du 13 juin 2006 relative à la transparence et à la sécurité en matière nucléaire.

15 *Loi* no 2015-992 du 17 août 2015 relative à la transition énergétique pour la croissance verte, art 126, 127.

16 *ibid* art 1.

17 A Faro, ‘The Legalities of Leaving Nuclear’ (2013) 69 *Bull At Sci* 1, 36–42.

18 L Andriamasy, C Barros and Q Liang, ‘Technical Efficiency of French Nuclear Energy Plants’ (2014) 46 *Appl Econ* 18, 2119–26; CP Barros and S Managi, ‘French Nuclear Electricity Plants: Productivity and Air Pollution’ (2016) 11 *Energy Sources* 8, 718–24.

19 C Cany and others, ‘Nuclear and Intermittent Renewables: Two Compatible Supply Options? The Case of the French Power Mix’ (2016) 95 *Energy Policy* 135–46; R Malischek and J Trüby, ‘The Future of Nuclear Power in France: an Analysis of the Costs of Phasing-out’ (2016) 116 *Energy* 908–21.

20 K Baker, ‘Using Cultural Theory to Analyze the Metagovernance of the Nuclear Renaissance in Britain, France, and the United States’ (2017) 34 *RPR* 2, 233–54; Pin Lee and Gloaguen (n 10) 86–199.

21 K Andriopoulos and S Silvestre, ‘French Energy Policy: A Gradual Transition’ (2017) 106 *Energy Policy* 376–81.

For the discussion in this article, the author uses different terms, which need clarification. In French law, the post-operational phases in the life of a nuclear reactor are named *mise à la fermeture*,²² translated as shutdown and *démantèlement*,²³ translated as dismantling. There is then no direct translation of the term 'decommissioning'.

Concerning forced shutdown, it refers to the closing of the operational phase of a nuclear reactor decided by another legal person than the operator of the facility. In this case, ordered by the Government and for reasons not limited to a direct safety threat.

The following discussion is organized in four parts. First, the article describes the legal framework for the shutdown of nuclear facilities in France before the 2015 Energy Transition Act. Secondly, it analyses the Energy Transition Act and its ambitious nuclear reduction targets supplemented by inadequate tools. Thirdly, it assesses the remaining legal barriers to a forced shutdown process. And fourthly, the conclusion highlights the key takeaways of this research.

2. THE LEGAL FRAMEWORK FOR THE SHUTDOWN OF NUCLEAR REACTORS IN FRANCE BEFORE THE ENERGY TRANSITION ACT

Prior to the Energy Transition Act, the shutdown of nuclear facilities was possible in two cases: voluntarily, by request of the operator of the facility, or under constraint, for safety reasons.

Voluntary shutdown by request of the operator

The most common way to organize the shutdown of a nuclear reactor under the pre-Energy Transition Act regime was by request of the facility operator,²⁴ EDF, the only operator in France.²⁵ In essence, the shutdown and dismantling of the nuclear facility required a prior authorization²⁶ delivered by the ministry in charge of energy after the opinion of the Nuclear Safety Authority (ASN)²⁷ and a public enquiry.²⁸ A 2007 decree specified that the operator was required to inform the authorities (ministers in charge of nuclear safety and ASN) at least three years before the intended shutdown date.²⁹ An ad hoc decree could then be adopted to allow the operator to proceed to the shutdown and dismantling, specifying the safety measures to be taken.³⁰

Forced shutdown for safety reasons

Under the former regime, it was possible to order the shutdown of a nuclear reactor, but only for safety reasons.

Article L593-1 of the Environment Code stated that nuclear facilities were submitted to a special legal regime because of the risks or harms that they can present for public safety and health, or for the protection of nature and of the environment. If a malfunctioning nuclear facility could have an impact on these concerns,

22 Environment Code, art L 593-4, para 1.

23 *ibid*.

24 Particularly in: Environment Code, arts L593-25 to -28.

25 'Nuclear Power in France' *World Nuclear Association* (October 2017) <<http://www.world-nuclear.org/information-library/country-profiles/countries-a-f/france.aspx>> accessed 17 November 2017.

26 Environment Code, *ibid* para 1.

27 See more at Nuclear Safety Authority's webpage <www.french-nuclear-safety.fr/> accessed 9 April 2018.

28 Environment Code, art L 593-26, para 1.

29 *Décret* no 2007-1557 du 2 novembre 2007 relatif aux installations nucléaires de base et au contrôle, en matière de sûreté nucléaire, du transport de substances radioactives, art 37.

30 *ibid* art 38.

a decree could be adopted after opinion of the *Conseil d'Etat*³¹ and of the ASN to order its irrevocable shutdown and dismantling.³² The threat must, however, be serious and the provisions of the Environment Code be ineffective to prevent or reduce these risks adequately.³³ These two criteria are cumulative.³⁴ These limitations on the discretion of the Government exist to prevent abuse of this provision, consisting of the forced shutdown of a reactor which could otherwise be kept running according to the ASN and the operator.

As a result, before the Energy Transition Act, the Government had no legal tools to decide unilaterally on the shutdown of the nuclear reactors in France on the ground of its energy policy.

3. THE ENERGY TRANSITION ACT: AMBITIOUS NUCLEAR REDUCTION TARGETS, INADEQUATE TOOLS

The Energy Transition Act was labelled as 'one of the most important texts of the five-year term' by President François Hollande.³⁵ This section analyses the provisions of this act related to forced nuclear reactor shutdown: first, by detailing its climate and nuclear objectives; secondly, by analysing the tools it provides to reduce the share of nuclear energy in the electricity mix; and thirdly, by highlighting the still missing tools to force the shutdown of nuclear reactors on the basis of energy policy decisions (without having to pay expensive compensations for expropriation).

A flagship energy act with ambitious climate and nuclear objectives

As Kostas Andriosopoulos and Stephan Silvestre state, although '[h]istorically based on independence and sobriety criteria, French energy policy [and regulation] now prioritises the environmental and climate impact of its energy mix.'³⁶ However, this new orientation actually started prior to the Energy Transition Act,³⁷ although it considerably modified the state's energy policy enshrined in Articles L100-1 to -4 of the Energy Code. Article L100-1 now places green growth³⁸ at the top of energy policy, elaborates on already existing concerns (energy independence, competitive economy, energy affordability, environmental protection, guaranteed access to energy) and adds a new one: the contribution to the implementation of a European Union (EU) Energy Union.³⁹

Article L100-4 of the Energy Code formulates the new targets of the national energy policy, as written in Article 1 of the Energy Transition Act. In these, France pledges to reduce its greenhouse gases emissions by three-quarters in 2050 compared to 1990, its final energy consumption by half by 2050 in comparison to 2012, and its primary energy consumption of fossil fuels by 30 per cent by 2030 compared to 2012 as well. Renewable energies are supposed to reach 32 per cent of the gross final energy consumption by 2030, representing 40 per cent of the electricity production that year. In addition, as mentioned earlier, the energy policy goals also include the 75–50 by 2025 nuclear target.

31 The highest court for litigations involving the administration in France, and adviser of the Government on the legality for some of its drafts of law or decrees.

32 Environment Code, art L593-23.

33 *ibid.*

34 Lahorgue (n 12) 34.

35 'Transition énergétique : Hollande détaille sa vision et veut accélérer' *Le Monde* (20 September 2013) <www.lemonde.fr/planete/article/2013/09/20/hollande-detaille-sa-vision-de-la-transition-energetique_3481711_3244.html#DRPmFXIK6HKdZTv2.99> accessed 17 November 2017.

36 Andriosopoulos and Silvestre (n 21) 376.

37 *ibid.* 377.

38 Defined as 'an economic development pattern respectful of the environment, at the same time energy-, resources- and carbon-efficient, socially inclusive, supporting the innovation potential and guardian of business competitiveness', see Energy Code, L 100-1 para 1.

39 Energy Code, *ibid.* para 7.

These targets are almost unanimously described as being ambitious by the media,⁴⁰ different businesses representatives,⁴¹ and legal scholars.⁴² Yet, some environmental non-governmental organizations consider them as insufficient to adequately address the challenge of climate change and the necessary reduction of CO₂ emissions.⁴³

The inadequate tools provided by the Energy Transition Act to reduce the share of nuclear energy in the electricity production mix

According to the *Cour des Comptes* (Court of Auditors), reaching the nuclear energy 75–50 by 2025 target will require the shutdown of 17–20 reactors.⁴⁴ The Energy Transition Act then provided a set of three mechanisms supposed to allow the Government to force the shutdown of various nuclear energy reactors for energy policy reasons.

The installed nuclear capacity cap

The first of these tools is the provision capping the total installed nuclear capacity at the 2015 level: 63.2 GW. New Article L311-5-5 paragraph 1 of the Energy Code specifies that an operating licence cannot be delivered if it raises the installed capacity above this level. Consequently, to commission the third-generation nuclear reactor (a European Pressurised Reactor, or EPR) which it is currently building in Flamanville, Manche (50), EDF will have to decommission an equivalent capacity, 1650 MW,⁴⁵ at the same time. This provision was validated by a decision of the *Conseil constitutionnel* (CC), considering it compatible with the Constitution (and with the connected Declaration of the Rights of Man and of the Citizen of 1789, called DDHC) and especially the right to private property (an issue studied deeper further below).⁴⁶

Yet, this mechanism does not place the Government in a position to deliver on its nuclear 75–50 by 2025 target. Indeed, the electricity consumption in France stagnated since 2011 and the projections foresee a reduction by 2021 from 479 to 471 Terawatt hour (TWh)/year.⁴⁷ To stabilize the nuclear installed capacity will, therefore, not be sufficient to automatically diminish its share in the electricity mix, as the total consumption of electricity is expected to decrease (as expected by the targets set in the act).

- 40 P Le Hir, 'La loi sur la transition énergétique définitivement adoptée au Parlement' *Le Monde* (22 July 2015) <www.lemonde.fr/energies/article/2015/07/22/vote-final-pour-la-loi-de-transition-energetique_4693996_1653054.html> accessed 17 November 2017 ; 'Les grandes lignes de la loi de transition énergétique' *Les Echos* (22 juil 2015) <www.lesechos.fr/industrie-services/energie-environnement/0203835212884-une-loi-pour-la-transition-energetique-1050492.php#> accessed 11 November 2015.
- 41 'Loi Transition Énergétique et Croissance Verte : L'UFE salue un texte ambitieux mais reste dubitative sur les capacités de sa mise en œuvre' (*Union Française de l'Électricité*, 23 July 2015) <ufe-electricite.fr/presse/communiqués-de-presse/article/loi-transition-energetique-et> accessed 17 November 2017 ; 'Des objectifs ambitieux pour la France mais des mesures qui ne permettront pas de les atteindre' *France énergie éolienne* (4 March 2015) <<http://fee.asso.fr/actu/loi-de-transition-energetique-des-objectifs-ambitieux-pour-la-france-mais-des-mesures-qui-ne-permettront-pas-de-les-atteindre/>> accessed 5 March 2016.
- 42 A Darson, 'Projet de loi sur la transition énergétique : ce qui attend les énergies renouvelables' (2015) *Droit de l'Environnement*, 162. J Sénéchal, 'La transition énergétique, aujourd'hui et maintenant ?' (2015) *RDI*, 449. P Villeneuve, 'La mobilité durable et les collectivités territoriales dans la loi relative à la transition énergétique' (2016) *AJCT*, 25.
- 43 A Bringault, 'Transition énergétique : les bonnes intentions iront-elles jusqu'à la concrétisation ?' *Transition-energetique.org* (23 July 2015) <www.transition-energetique.org/2015/07/transition-energetique-les-bonnes-intentions-iront-elles-jusqu-a-la-concretisation.html> accessed 29 July 2015.
- 44 *Cour des comptes* (n 9) 130.
- 45 'FLAMANVILLE 3 EPR PROJECT' EDF (2017) <www.edf.fr/en/groupe-edf/producteur-industriel/carte-des-implantations/centrale-nucleaire-de-flamanville-3/presentation> accessed 17 November 2017.
- 46 CC, 13 August 2015, déc no 2015-718 DC, *Loi relative à la transition énergétique pour la croissance verte*, para 55–60.
- 47 RTE, 'Bilan prévisionnel de l'équilibre offre-demande d'électricité en France – Edition 2016' (2016) 38, <www.rte-france.com/sites/default/files/bp2016_complet_vf.pdf> accessed 24 November 2017.

The strategic plan

The second tool created by the Energy Transition Act to allow the forced shutdown of various nuclear reactors is the strategic plan presented in Article L311-5-7 of the Energy Code. According to its first paragraph, each operator producing more than a third of the national electricity output (thus concerning only EDF⁴⁸) has to establish a strategic plan, presenting the action it commits to implement in order to respect the security of supply and diversification of the electricity production targets set into the multiannual energy plan (MEP in English, PPE—*programmation pluriannuelle de l'énergie*—in French).

In a nutshell, the MEP, created by Article 176 of the Energy Transition Act, is a 'comprehensive strategy which covers all aspects of energy policy and all forms of energy'.⁴⁹ Established by the Government with the participation of various stakeholders and revised every five years, its most authoritative part is a decree defining, amongst other things, the expected installed capacity for each renewable source of electricity to be attained at the end of each period.⁵⁰

The strategic plan suggests evolutions to undertake regarding electricity generation facilities, 'in particular of nuclear energy', to reach the MEP's targets.⁵¹ This plan must be submitted for validation to the minister in charge of energy a maximum of 6 months after the publication of the MEP,⁵² and a new one must be prepared if it is not compatible.⁵³ Lastly, the operator reports each year to specialized permanent commissions of the Parliament on the implementation of the plan and on its contribution to the targets of the MEP.⁵⁴

The strategic plan is, therefore, supposed to constitute a privileged instrument to control the fulfilment of the Energy Transition Act targets and particularly of the one concerning nuclear electricity. In reality however, this tool seems unable to allow the forced shutdown of nuclear facilities for energy policy reasons. First of all, it had to build on a particularly blurry MEP regarding the contentious topic of nuclear reduction (nuclear being already the source of a long delay suffered by the MEP⁵⁵). As a result, the MEP set a paltry and insufficient nuclear electricity production decrease objective of 10–65 TWh by 2023 compared to 2016.⁵⁶ Keeping in mind that the total nuclear output this year was 384 TWh (already quite low⁵⁷), such an insignificant reduction by 2023 does not place France on track to reach its 2025 nuclear share target. Secondly, this plan is prepared by EDF, the operator of the nuclear reactors, which will probably favour its financial interest over France's energy policy. Thirdly, the Government can only influence its outcome by the validation process, as it can reject it if unsuitable. This happened on 21 April 2017 when the then minister in charge, Ségolène Royal, asked EDF to revise its strategic plan, deemed incompatible with the electricity production diversification goals of the MEP, especially concerning the shutdown of nuclear and coal reactors.⁵⁸ But this capacity to reject the plan does not guarantee that the new version will be compatible, as no provision allows the Government nor any other actor to take responsibility for it. The situation can remain

48 With its nuclear fleet alone, it is producing around 75% of the electricity in France.

49 'The Multiannual Energy Plan' (2017) Ministère de la Transition écologique et solidaire 1 <www.ecologique-solidaire.gouv.fr/sites/default/files/4pages_PPE_GB_DEF_Web.pdf> accessed 17 November 2017.

50 The first one was adopted in October 2016 by the *Décret* no 2016-1442 du 27 octobre 2016 relatif à la programmation pluriannuelle de l'énergie. Full version of the MEP available <www.ecologique-solidaire.gouv.fr/sites/default/files/PPE%20int%C3%A9gralit%C3%A9.pdf> accessed 17 November 2017.

51 Energy Code, art L311-5-7 para 2.

52 *ibid* para 3.

53 *ibid* para 4.

54 *ibid* para 5.

55 Originally to be published at the end of 2015, it was finally out the 27 October 2016. J Schorpp, 'Transition énergétique : boucler la PPE en quelques mois s'annonce difficile' *Contexte* (11 March 2015) <www.contexte.com/article/energie/transition-energetique-le-baclage-de-la-ppe-en-quelques-mois-face-a-des-difficultes_27779.html> accessed 12 March 2016.

56 MEP, 'Volet relatif à l'offre d'énergie' (Ministère de l'Ecologie, du Développement durable et de l'Energie, 27 October 2016) 43.

57 RTE, 'Bilan électrique 2016' (2016) <<http://bilan-electrique-2016.rte-france.com/production/le-parc-de-production-national/>> accessed 24 November 2017.

58 'EDF encouragé à modifier son plan stratégique' *Batiweb* (5 May 2017) <www.batiweb.com/actualites/vie-des-societes/edf-encourage-a-modifier-son-plan-strategique-05-05-2017-30431.html> accessed 17 November 2017.

obstructed and the planning of the necessary shutdowns to comply with the 2015 act is increasingly becoming more constrained by time. As of February 2018, no new plan has been submitted by EDF. Fourthly, the Energy Transition Act does not require the plan to be made publicly available. Thus, the version submitted to the minister in April 2017 was not published, only a press release indicated that the board of EDF had validated its submission to the ministry,⁵⁹ impeding the public to check its assumptions.

Subsequently, the delegation by the Government to EDF of the responsibility to plan and organize the shutdown of numerous nuclear reactors seems not to be the best way to achieve the nuclear energy reduction target.

The Government commissioner

A third tool aimed at controlling the shutdown plans is created by the same Article L311-5-7 of the Energy Code, but paragraph 6. On this basis, a Government commissioner is placed in each operator producing more than a third of the national electricity output. This commissioner is informed of investment decisions and can oppose them if incompatible with the goals of the strategic plan or, if it does not exist, with the MEP. According to paragraph 7, this opposition needs to be confirmed by the minister in charge of energy, and then the concerned investment decision can only be applied if the strategic plan is revised, in the same conditions as for its initial elaboration.

This tool, supposed to ensure a tightened control over the shutdown goals, appears to be at best able to freeze the situation until the validation of a strategic plan, instead of fostering proactive governmental action on this matter.

Therefore, the new legal tools provided by the Energy Transition Act to force the shutdown of nuclear energy facilities fail to provide any guarantee that its own targets will be reached. Yet, additionally to or instead of these tools, the lawmaker could have implemented other ones already in place in other countries.

The missing tools to force the shutdown on the basis of energy policy

Although the Energy Transition Act brought some changes to the sections of the Environment Code dealing with nuclear facility operation, shutdown and decommissioning,⁶⁰ the most needed tool to comply with the act's targets was not included: a forced shutdown mechanism on the basis of state's energy policy.

Indeed, the two possible options to shut down a nuclear reactor remain the ones seen earlier in this article: after voluntary request of the operator or ordered for safety reasons. It constitutes a missed opportunity, especially as Article 187 of the Energy Transition Act modified the conditions to grant an operation licence for electricity production facility, including criteria such as the energy nature, source and its role in the achievement of Article L100-4 of the Energy Code's targets,⁶¹ and a compatibility requirement with the MEP.⁶² Moreover, nuclear reactors, formerly not submitted to such authorization,⁶³ are now integrated into the common regime.⁶⁴ As the energy policy goals are integrated into the authorization criteria, they could have been into the shutdown criteria too.

Such a provision was already adopted in at least two other European countries: Sweden and Germany. In Sweden, on 18 December 1997, the Act (1997: 1320) on the Phasing-Out of Nuclear Power was adopted,

59 'Examen par le Conseil d'administration d'EDF du plan stratégique déclinant la première période de la Programmation Pluriannuelle de l'Energie (PPE)' EDF (6 April 2017) <www.edf.fr/groupe-edf/espaces-dedies/journalistes/tous-les-communiques-de-presse/examen-par-le-conseil-d-administration-d-edf-du-plan-strategique-declinant-la-premiere-periode-de-la-programmation-pluriannuelle-de-l-energie-ppe> accessed 17 November 2017.

60 See *Loi* no 2015-992 (n 15), art 126, 127.

61 Energy Code, art L311-5, 2°.

62 *ibid* para 7.

63 P Sablière, 'Le pilotage de la production d'électricité dans la loi de transition énergétique' (2015) 10 *Énergie – Environnement – Infrastructures*, dossier 7, 3.

64 Energy Code, art L311-5-6.

allowing the Government ‘to revoke a permit to operate a nuclear power reactor on a date to be decided by the Government’, in order to organise ‘the transformation of the energy system’. The criteria to take the shutdown decision include location, age, design and importance to the national energy supply of the reactor. The act also provided for a compensation to be given to the operator, calculated on an estimated lifespan of 40 years.⁶⁵ As Olav Torp and Ole Jonny Klakegg highlight, the two reactors shutdown in Barsebäck in the years following the adoption of the act were situated at ‘30 km from Malmö and only 20 km from Copenhagen, Denmark’, cumulating ‘more than three million people in two countries [living in their] neighbourhood’.⁶⁶ The supreme administrative court validated the mechanism and the justification for the shutdown of the Barsebäck reactors, because of their location.⁶⁷ Some French nuclear plants could be shut down on this basis, as many nuclear plants are situated close to important cities and/or borders.⁶⁸

In Germany, the Government went further as it directly planned and organized the nuclear energy full phase-out through a 2002 amendment to the German Atomic Energy Act. This amendment is the legal translation of an agreement reached between the nuclear plants’ operators and the Government.⁶⁹ Alongside the prohibition to build any new reactor, the amendment limited the running reactors to an ‘average operating period of 32 years’ since their commissioning date, maintaining ‘an average residual operating period for German nuclear power plants of about 11.5 years’.⁷⁰ This high foreseeability allowed the utilities to assess and plan their investments until the shutdown due date and for the state to be exempted of paying compensations.⁷¹ The German case experienced troubles when in 2010 the production quotas were extended, before to be brought back to their original level in 2011 after the Fukushima accident (with some immediate shutdowns). The concerned operators then sued the state to obtain compensations for their 2010/2011 investments⁷² but the German Federal Constitutional Court validated the new phasing-out text, with the obligation however, for it to include compensations.⁷³ These models of legislations could have been applied as well in France, but nothing close took place.

As no proper forced shutdown tool was adopted in the Energy Transition Act, a definite operation lifespan for nuclear reactors could have been created. Currently, there is none in France and the regime relies on 10-yearly ASN’s inspections.⁷⁴ If such a limit would be implemented, then to extend it would require an administrative order which could be based on criteria including the achievement of Article L100-4 and MEP’s targets, namely the nuclear 75–50 by 2025 target.

In the absence of these provisions, the real decision makers regarding nuclear reactors shutdown in France remain their operator and the ASN but not the Government. Consequently, as Kostas Andriosopoulos and Stephan Silvestre report, the 75–50 by 2025 target ‘remains theoretical to date’.⁷⁵

4. THE REMAINING LEGAL BARRIERS TO A FORCED SHUTDOWN PROCESS

The lack of adequate tools to force the shutdown of various nuclear reactors in France after the Energy Transition Act can be illustrated by the Fessenheim case, the first shutdown planned after its adoption.

65 ‘Sweden – General Legislation’ (1998) 61 Nuclear L Bull 86.

66 O Torp, and O J Klakegg, ‘Challenges in Cost Estimation under Uncertainty—A Case Study of the Decommissioning of Barsebäck Nuclear Power Plant’ (2016) 6 Admin Sci 14, 9.

67 ‘Case Law – Sweden’ (1999) 64 Nuclear L Bull 44.

68 See eg Nogent-sur-Seine, 110 km from Paris; Fessenheim, 75 km from Strasbourg, 40 of Bâle (Switzerland) and on the border with Germany; Cattenom, 35 km from Luxembourg; Bugey, 25 km from Lyon and 100 km from Geneva or Gravelines, 85 km from Lille.

69 A Vorwerk, ‘The 2002 Amendment to the German Atomic Energy Act Concerning the Phase-out of Nuclear Power’ (2002) 69 Nuclear L Bull 8.

70 *ibid* 10.

71 A Rossnagel and A Hentschel, ‘The Legalities of a Nuclear Shutdown’ (2012) 68 Bull At Sci 6, 61.

72 M Ludwigs, ‘Germany’s Nuclear Phase-Out and the Right to Property’ (2016) 4 ENLR, 43.

73 BVerfG, Judgment of the First Senate on 06 December 2016 - 1 BvR 2821/11 <https://www.bundesverfassungsgericht.de/SharedDocs/Entscheidungen/EN/2016/12/rs20161206_1bvr282111en.html> accessed 9 April 2018.

74 Environment Code, art L593-18 and -19.

75 Andriosopoulos and Silvestre (n 21) 380.

During his 2012 presidential campaign, François Hollande promised to shut down the Fessenheim plant for three reasons: its age, being the oldest nuclear plant operated in France with its two reactors commissioned in 1978; its location, in an earthquake zone and below the level of the Grand Canal of Alsace; and for its proximity to the German and Swiss borders.⁷⁶ However, these motives do not constitute an immediate safety risk according to the ASN,⁷⁷ and then do not allow the Government to order the shutdown of nuclear reactors in Fessenheim, Haut-Rhin (68), on the basis of Article L593-23 of the Environment Code, without having to pay massive compensations for expropriation. The only way for the Government to shut down Fessenheim (as a first part of its 75–50 by 2025 target to respect the nuclear cap when the EPR in Flamanville will be commissioned) would then be to negotiate with the operator of the plant, EDF. The purpose would be to reach an agreement in order to discourage EDF to sue the Government for a higher compensation—even though EDF is a subsidiary of the state, holding 83.1 per cent of its shares.⁷⁸

This negotiation is framed by the interpretation given to a couple of legal barriers: private property rights concerning the creation and operating authorizations, and the principle of legitimate expectation, which may have a direct impact on the creation of a compensation mechanism.

The right to private property

The question of the right to private property is a sensitive issue when it comes to forced shutdown of nuclear reactors, as it could possibly constitute a violation of this ‘sacred’⁷⁹ right. Therefore, both the 75–50 by 2025 target and the nuclear installed capacity cap were presented to the CC in order to decide whether or not they breach this right.

In its decision of 13 August 2017, the CC provided elements based on private property right and the operating authorization for electricity production facilities regarding the installed nuclear capacity cap. The question here was: as Article 187 of the Energy Transition Act limits the total installed nuclear capacity to 63.2 GW (the total amount operated in 2015), while a total of 64.85 GW of creation and operating authorizations was already delivered, are these both types of authorizations⁸⁰ providing their holder with a property right?

The CC clearly answers that the authorization to operate an electricity production facility cannot be considered as an asset subject to property rights by its holder.⁸¹ By consequence, there can be no expropriation. As for the creation authorization delivered, the judge moves the debate to the ground of the principle of legitimate expectation.

The principle of legitimate expectation

It must be specified beforehand that the principle of legitimate expectation is not applied *per se* by the judge in France, apart for specific matters, such as European⁸² or tax law.⁸³ Yet, legal scholars consider that the essence of this principle is applied through a proxy labelled by the CC as ‘legally established situation based

76 ‘Hollande : “Une centrale fermée en 5 ans” *Le Figaro* (2 May 2012) <<http://elections.lefigaro.fr/flash-presidentielle/2012/05/02/97006-20120502FILWWW00700-hollande-je-ne-fermerai-que-fessenheim.php>> accessed 17 November 2017.

77 ASN, ‘Poursuite d’exploitation du réacteur n°2 de la centrale nucléaire de Fessenheim après trente années de fonctionnement’ (2013) 12.

78 ‘Les participations publiques – Energie’ *Agence des participations de l’Etat* (2016–2017) <www.economie.gouv.fr/files/files/directions_services/agence-participations-etat/Panorama_sectoriel_Energies.pdf> accessed 17 November 2017.

79 Mentioned as such in the DDHC of 1789, art 17 <www.conseil-constitutionnel.fr/conseil-constitutionnel/francais/la-constitution/la-constitution-du-4-octobre-1958/declaration-des-droits-de-l-homme-et-du-citoyen-de-1789.5076.html> accessed 24 November 2017.

80 The creation authorization specifically for a nuclear reactor, added to the general operating authorization for all electricity production facilities.

81 CC, 13 August 2015, déc no 2015-718 DC (n 46) para 56.

82 L IL, ‘Le principe de confiance légitime serait-il entré en droit public interne ?’ (2017) 3 Petites affiches, 6–7.

83 L Tartour, ‘Le principe de protection de la confiance légitime en droit public français’ (2013) 2 RDP, 311–12.

on the guarantee of the rights proclaimed in article 16 DDHC'.⁸⁴ This notion benefits from an extensive jurisprudence of the CC to determine the criteria for dismissing the protection of the legally established situation in the name of the general interest and in order to preserve the role of the lawmaker. Even when it causes a negative impact on the incumbent actors' situation.⁸⁵

In its decision of 13 August 2017, the CC acknowledges that the installed nuclear capacity cap affects the legitimately expected outcome of the legally established situations, that is to say, the authorization to create the nuclear reactor EPR at Flamanville.⁸⁶ Indeed, the holder of this authorization could have expected to receive an operating authorization once that the facility is completed and commissioned⁸⁷ (even though there is no guarantee of such deliverance). However, the judge justifies this infringement of the rights of EDF in three points.

First, the capping provision only creates effect when a new facility raises the total installed capacity over 63.2 GW. Consequently, there is no immediate abrogation of any authorization. Secondly, the mechanism lets the authorizations holder choose which facility it will shut down to compensate the commissioning of the Flamanville reactor. At least this is what the law states, but in reality there is a strong political pressure to shut down the Fessenheim plant first. Thirdly, it results from the parliamentary debates that the lawmakers intended to reach the diversification of the energy mix goal and to reduce the share of nuclear energy in the electricity mix. The CC then estimates that this measure is based on general interest objectives. Therefore, the infringement over EDF's legally established situation is justified by sufficient and proportionate general interest purposes regarding the objectives pursued.⁸⁸

Additionally, the CC specified clearly that the holder of an authorization of creation which would have lost the possibility to obtain an operating authorization can still request a compensation, hereby guaranteeing it can enjoy its rights.⁸⁹ And this possibility leads to the following lines, which analyse the first of these bargains for compensation between EDF and the Government.

The calculation of the operator's compensation: the case of Fessenheim

As EDF cannot claim expropriation in front of the judge but can still request a compensation for the forced shutdown of Fessenheim, this led to a negotiation between EDF and its principal shareholder, the state. As a 2015 parliamentary report highlights, the cost calculation for the shutdown and dismantling of a nuclear reactor is not an easy task.⁹⁰ Moreover, the lack of legal tools highlighted earlier means that a methodology to evaluate this cost must be elaborated as follows: evaluation of the cost of ending the operation; evaluation of the potential prejudice entitled for compensation, built on the expected remaining operational lifespan; and finally the cost of dismantling.⁹¹ Legally, the theory of the loss of opportunity could be used, limiting the compensation to the abnormal burden that the claimant could not have legitimately anticipated.⁹² If EDF is unsatisfied of the compensation attributed by negotiation, it can then file a complaint to the judge and request another compensation amount, based on a different calculation of the years the reactor is still expected to be operated, the cost per kWh, and the selling price on the electricity market.

84 B Mathieu, 'Sécurité juridique. Le respect de la légitime confiance des citoyens s'impose au législateur' (*Le Club des Juristes*, 27 January 2014) <www.leclubdesjuristes.com/les-publications/securite-juridique-le-respect-de-la-legitime-confiance-des-citoyens-simpose-au-legislateur/> accessed 10 March 2017.

85 B Plessix, 'Sécurité juridique et confiance légitime' (2016) 3 RDP, 799–806.

86 *Décret* no 2007-534 du 10 avril 2007 autorisant la création de l'installation nucléaire de base dénommée Flamanville 3, comportant un réacteur nucléaire de type EPR, sur le site de Flamanville (Manche).

87 CC, 13 August 2015, déc no 2015-718 DC (n 46) para 57.

88 *ibid* para 58.

89 *ibid* para 59.

90 Mission d'information commune sur l'application de la loi no 2015-992 du 17 août 2015 relative à la transition énergétique pour la croissance verte (2016) AN 4157, 251.

91 *ibid* 255.

92 See C Broyelle, 'Les conditions de mise en jeu de la responsabilité du fait des lois' (2012) 5 *Droit Administratif*, comm 53, 4.

However, in 2017, an agreement was reached when EDF obtained satisfaction on a list of requests⁹³:

First, the Government extended the soon-to-expire creation authorization of the EPR reactor of Flamanville.⁹⁴ Secondly, the Government authorized the extension of the authorization of temporary shutdown for the reactor Paluel 2, stopped for a longer time than planned because of an accident during the replacement of a core piece of the reactor.⁹⁵ Thirdly, the state will pay €490 million by 2021 to EDF, added to complementary payments until 2041 calculated on the electricity market price and the average production of other reactors similar to the ones in Fessenheim.⁹⁶ Fourthly, this agreement was validated by the European Commission, concerning state aid law.⁹⁷

Multiple criticisms can be made about this agreement. It is not available to the public, impeding the unveiling of the calculation methodology, even though public money is engaged. The Government implicitly asserts that a nuclear reactor can be operated for 60 years or more by accepting a compensation until 2041 (the reactors were commissioned in 1978), while not a single reactor in France has ever reached this age. Lastly, the sum agreed on by the Government seems disproportionate in comparison with the amount that will probably be paid by the German Government after the 2010/2011 reversal for the shutdown of 17 reactors, estimated at a maximum of €2 billion,⁹⁸ while the same operation for the two oldest reactors running in France will cost the taxpayer over €500 million. This expensive deal is the sanction for the lack of coherence between the Government's targets and its legal tools, and for the lack of foreseeability provided to EDF.

Finally, on 6 April 2017, the board of EDF declared the shutdown of its two reactors at Fessenheim 'irreversible and inescapable'.⁹⁹ But the utility specified that this shutdown will be launched at the moment the Flamanville reactor is commissioned, and at the condition that its shutdown is 'necessary to respect the legal cap of 63.2 GW'.¹⁰⁰ In this way, EDF expects to spare its Fessenheim reactors if finally other ones are shut down before, such as the temporarily stopped Paluel 2. Two days later, on 8 April 2017, the minister in charge of energy adopted a decree stating in Article 1 that the operating authorization of Fessenheim's reactors was abrogated, before adding in Article 2 that this abrogation will take place when EDF's last conditions are met.¹⁰¹ The problem is that the legal quality of this decree is deemed as very poor by legal scholars. The anticipation of the legal effect of a request by the operator which did not occur yet and that remains uncertain is a matter of concern. As Julie Laussat writes, 'the regulatory power abrogates an authorisation at the condition that its holder asks him to do so'.¹⁰² Thus, at the image of the legal regime to force the shutdown of nuclear reactors after the Energy Transition Act, this decree seems inefficient, inappropriate, and more about symbols than actual legal framework building.

93 EDF, 'Comptes consolidés au 31 décembre 2016', 49 '3.7 Protocole d'indemnisation relatif à la fermeture de la centrale de Fessenheim' <www.edf.fr/sites/default/files/contrib/groupe-edf/espaces-dedies/espace-finance-fr/informations-financieres/informations-reglement-ees/resultats-annuels/2016/pdf/2016-comptes-consolides-20170214.pdf> accessed 24 November 2017.

94 *Décret* no 2017-379 du 23 mars 2017 modifiant le décret no 2007-534 du 10 avril 2007 autorisant la création de l'installation nucléaire de base dénommée Flamanville 3, comportant un réacteur nucléaire de type EPR, sur le site de Flamanville (Manche).

95 *Arrêté* du 26 janvier 2017 prorogeant la durée d'arrêt de fonctionnement de l'installation nucléaire de base no 104 exploitée par Electricité de France-société anonyme (EDF-SA) située sur la commune de Paluel (Seine-Maritime).

96 EDF (n 93).

97 F Roussel, 'Fermeture de Fessenheim : toutes les conditions sont remplies' *Actu-environnement* (27 March 2017) <www.actu-environnement.com/ae/news/fermeture-fessenheim-conditions-remplies-28712.php4#xtor=EPR-1> accessed 28 March 2017.

98 B Wehrmann, 'Germany's constitutional court backs speedy nuclear exit' *Cleanenergywire.com* (6 December 2016) <www.cleanenergywire.org/news/germanys-constitutional-court-backs-speedy-nuclear-exit> accessed 11 March 2017.

99 'Conseil d'administration d'EDF du 6 avril 2017: Fessenheim' *EDF* (6 April 2017) <www.edf.fr/groupe-edf/espaces-dedies/journalistes/tous-les-communiqués-de-presse/conseil-d-administration-d-edf-du-6-avril-2017-fessenheim> accessed 3 July 2017.

100 *ibid.*

101 *Décret* no 2017-508 du 8 avril 2017 portant abrogation de l'autorisation d'exploiter la centrale nucléaire de Fessenheim.

102 J Laussat, 'Le décret du 8 avril 2017 : une abrogation atypique de l'autorisation d'exploitation de la centrale nucléaire de Fessenheim' (2017) 2 *La Revue Pau Droit Energie*, 16–17.

5. CONCLUSION

The nuclear energy landscape in France is marked by the ageing of its numerous reactors and by a changing legal framework, specifically concerning the rules applicable to their shutdown.

In an effort to promote the energy transition to renewable energy and diversify the electricity production mix, the Energy Transition Towards Green Growth Act adopted in 2015 established a set of targets to make steps into this direction, including the objective to reduce the share of the nuclear energy into this mix from an average of 75–50 per cent by 2025.

This article provided an analysis of the legal tools created by the Energy Transition Act supposed to facilitate the achievement of the objectives laid down for nuclear energy reduction, especially by shutting down reactors. This article argued that the three tools created by this law to facilitate nuclear reduction—installed nuclear capacity cap, strategic plan and Government commissioner—are inadequate to achieve this goal as all present serious loopholes or are simply not fitted for the forced shutdown of nuclear reactors on the basis of energy policy. Yet, other European countries, like Sweden and Germany, adopted appropriate legal provisions allowing to envisage the shutdown of a particular reactor (or of all of them) with foreseeability and rationality. They could have been reproduced and adapted in France, but so far, this has not been the case.

The failure of the Energy Transition Act led to the conduction of ad hoc negotiations between the Government and the operator of the nuclear fleet in order to agree on the shutdown of the oldest nuclear energy plant in France, Fessenheim. As stressed in this article, the first shutdown process since the adoption of the Energy Transition Act led to a costly agreement setting a dangerous precedent for taxpayers' money, crowned by a decree of inferior legal quality.

At the end of the day, the legal framework for the forced shutdown of nuclear energy reactors on the basis of energy policy in France moved from non-existent to inadequate and inefficient between prior-to-2015 and 2017. This situation seriously imperils the achievement of the electricity production diversification goals and the realization of the energy transition in France as decided by the Energy Transition Act in 2015.